

EE 201.3

(Instructors: Lynch/Teng)

Midterm Examination

Tuesday, October 25, 2005

7:00 PM

Time Allowed: 2 Hours

Materials allowed: One 8½" X 11" formula sheet,
Calculators

Instructions:

- Answer all questions in the space provided (use page backs for rough work if necessary)
- State your assumptions; show all relevant work. Box, circle, or otherwise highlight your answers.
- Put your name and student number on the cover page; put *only* your student number on all remaining pages.
- Weighting for each question is indicated in the left margin (Total marks: 100)

| 2 | 3 | 4 | 5 | 6 | Total |
|-----|-----|-----|-----|-----|---------|
| 8 | 8 | 4 | 20 | 18 | |
| /15 | /25 | /15 | /25 | /20 | 58 /100 |

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Professor Lynch

#10 b) Nothing for setting up question properly (minus double the area) and received no marks

Some potentially useful constants/relationships:

Acceleration of gravity: $g = 9.81 \text{ m/s}^2$

Permeability of free space: $\mu_0 = 4\pi \times 10^{-7} \text{ Wb/At-m}$

Magnetic field, B , a distance d from a wire carrying current I : $B = \frac{\mu_0 I}{2\pi d}$

Magnetic force of attraction: $F_{att} = \frac{B^2 A}{2\mu_0}$

- 1) Find the reluctance of a magnetic circuit if a magnetic flux $\Phi = 5.2 \times 10^{-4} \text{ Wb}$ is established by an impressed mmf of 400 A-t.

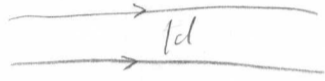
[2] $\mathcal{F} = \mathcal{R} \Phi \quad \mathcal{R} = \frac{\mathcal{F}}{\Phi} = \frac{400 \text{ At}}{5.2 \times 10^{-4} \text{ Wb}} = \underline{\underline{769.2 \text{ k} \frac{\text{At}}{\text{Wb}}}}$

- 2) Two long parallel conductors, separated by a distance $a = 10 \text{ cm}$, carry currents in the same direction. If $I_1 = 5 \text{ A}$ and $I_2 = 8 \text{ A}$, what is the force per meter unit length exerted on each conductor by the other?

[4] $B = \frac{\mu_0 I}{2\pi d} = \frac{(4\pi \times 10^{-7} \frac{\text{Wb}}{\text{Atm}})(8 \text{ A})}{2\pi(0.10 \text{ m})} = 1.6 \times 10^{-5} \text{ T}$

$F = \frac{B^2 A}{2\mu_0} = \frac{(1.6 \times 10^{-5} \text{ T})^2 (1.0 \text{ m})}{2(4\pi \times 10^{-7} \frac{\text{Wb}}{\text{Atm}})} = \underline{\underline{1.0 \times 10^{-5} \frac{\text{N}}{\text{m}}}}$

Wrong final.



Do they attract or repel each other?

[1] Attract ✓

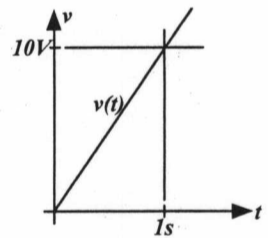
- 3) The voltage observed across a 1 Henry inductor is shown in the diagram. Assuming the current through the inductor at $t = 0$ is 0A, what is the current through the inductor at $t = 1 \text{ s}$?

- [4] i) 5A ii) 10A iii) 20A

$V = L \frac{di}{dt}$

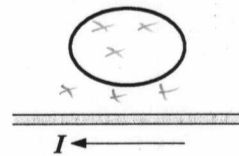
$10 \text{ V} = 1 \text{ H} \frac{di}{(1 \text{ s})}$

$di = 10 \text{ A}$



- 4) What is the direction of induced current in the oval loop when the current I in the wire shown below the loop decreases rapidly to zero?

- [2] i) Clockwise ii) Counterclockwise



- 5) Two bars are moving toward right on two parallel rails. If $v_1 > v_2$, determine the direction of current in the loop (before the first bar catches the second bar) formed by the two bars and the rails between them.

- [2] i) Clockwise ii) Counterclockwise

